Section 4: Affected Environment, Environmental Consequences, and Minimization

4.1 GENERAL This Section presents a discussion of the affected environment and the environmental consequences of the No Action and the Proposed Action alternatives. It provides an inventory of environmental resources identified within Makua and the surrounding area. It also discusses the environmental stewardship programs that the Army has developed and is implementing or is in the process of implementing in order to conduct training at Makua. Natural, socioeconomic and cultural resources addressed include: land use, geology and soils, climate, hydrology, flood hazard, vegetation and wildlife, threatened and endangered species, wildfire management, air quality, noise, socioeconomics, environmental justice, cultural resources, infrastructure, hazardous substances, transportation, and public involvement.

Discussions of the No Action and Proposed Action alternatives are a result of a variety of alternatives compared during preliminary alternatives analysis (see Section 3). The No Action and Proposed Action alternatives were selected to carry through further analysis because it was determined that other alternatives identified did not meet the purpose and need, incurred high costs, or generated more environmental impacts. Therefore, those alternatives were considered unreasonable or unfeasible and dismissed from further evaluation. The No Action and Proposed Action alternatives discussion addresses environmental impacts of the alternatives on Makua, the Waianae community, and the government.

4.2 LAND USE

4.2.1 Affected environment

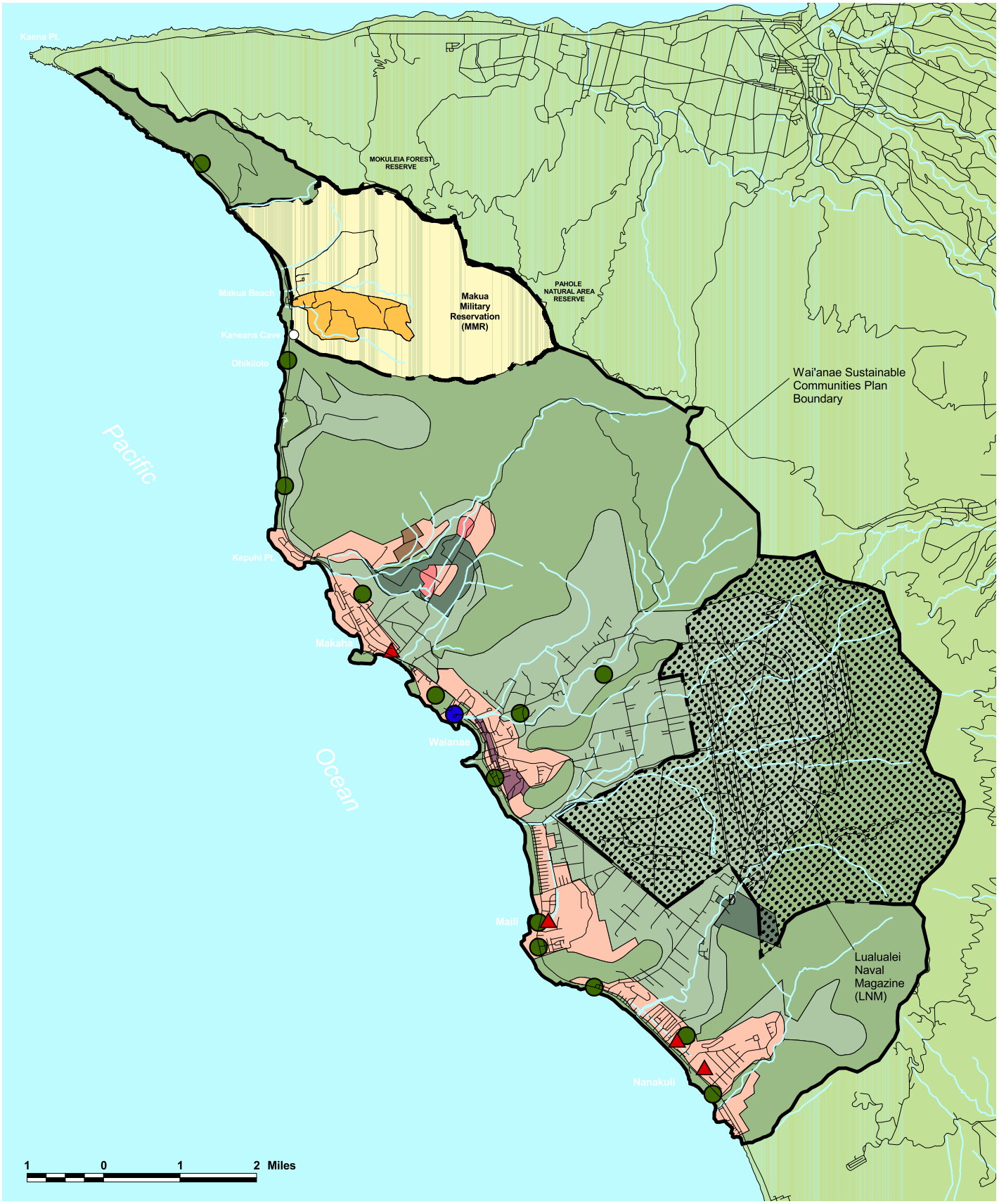
4.2.1.1 Makua Military Reservation Makua is 38 miles northwest of Honolulu on the western shore of Oahu near Kaena Point, is situated in Makua-Kahanahäiki valleys, is bordered to the west by the Pacific Ocean, and is surrounded by the Waianae Mountains to the north, east, and south. The valley is primarily undeveloped with various vegetation zones. Makua borders Farrington Highway (SR 93) and extends west from the Waianae Range ridgeline to the Pacific Ocean. It is approximately 3 miles north of Makaha, the nearest town.

Land use within Makua is designated for military training (Figure 4-1). Prior to the military use, the lands were used for agriculture and rural settlement, including a large cattle ranch during the 19th century. Makua Military Reservation was established in 1943 and originally comprised more than 7,300 acres. In the intervening years, the Army's holdings have been reduced to 4,190.47 acres, of which 170 acres are owned in fee simple, 3,236.48 acres are State of Hawaii ceded lands, 782.35 acres are leased from the State, and 1.64 acres are held by license (Figure 1-3). All property to the west of Farrington Highway has been made available to the public through the State of Hawaii for recreational purposes. While the Army maintains jurisdiction over 4,190.47 acres, only 1,034 acres are actually used for training and associated support activities, and the maneuver live-fire area is only 457 acres. The surrounding land is maintained and serves as a buffer that helps preserve threatened and endangered species and cultural resources.

As stated in the 22 July 1997 APVG-GWY Information Paper, "Land Ownership at Makua Military Reservation" (Information Paper, 1997), the current lease from the State of Hawaii was executed in 1964 and expires in 2029. Originally, 1,515 acres were leased; however, as a good faith gesture, the Army returned 732 acres including Yokohama Bay Beach (Keawaula) to the state in January 1990. Under the terms of its lease, the Army may restrict public use of the premises, post guards, and conduct traffic control along Farrington Highway when necessary. The Army must ensure the land between Farrington Highway and the shoreline is available to the public when it is not being used for training, and must allow State Land and Natural Resource employees to enter the leased premises when necessary. The Army is also obligated to allow the access to the Kaneana Cave and its associated foot and parking area (Information Paper, 1997).

The CCAAC at Makua is known as the Pilila'au Complex. It is fenced and closed to the public. Only portions of the southern valley, as illustrated in Figure 1-2, are used for maneuver live-fire training. Makua has also been used for Open Burning/Open Detonation (OB/OD) activities, which were discontinued in 1992. The Proposed Action does not include resumption of OB/OD activities.

Makua falls under the purview of ITAM, an Army-wide program that integrates Army training and other mission requirements for land use with sound natural resource management of the land. The primary purpose of the ITAM program is to prevent soil erosion and repair maneuver damage. The objectives of the program are to achieve optimum sustainable use of training lands by implementing actions that include inventorying and monitoring land conditions, integrating training requirements with land capacity, educating land users to minimize adverse impacts, and providing for land rehabilitation and maintenance.



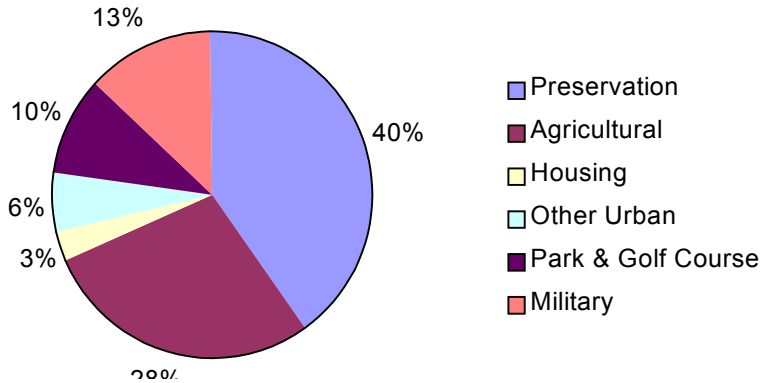
Sources: Waianae Sustainable Communities Plan, Dept. of Planning and Permitting, City and County of Honolulu, HI, July 1999

Figure 4-1: Land Use

4.2.1.2 Waianae and surrounding land use Gradual development has changed land use on the Island of Oahu over the years. Urban land use on Oahu has increased by approximately 15 percent, and preservation land use by 2 percent, between 1975 and 1988. In contrast, agricultural use has declined 10 percent. Current composition of land use on the Island of Oahu is illustrated in Figure 4-2. Makua is located on the northwest side of the Island of Oahu, on the Waianae Coast communities (referred to hereafter as Waianae). Makua and Waianae are both located within the Waianae District. A Special Area Plan Boundary encompasses a designated area that requires more detailed planning efforts beyond what is presented in the "Waianae Sustainable Communities Plan" (hereafter referred to as the Plan) (City and County of Honolulu, 2000). Figure 4-3 shows the extent of the area. The Waianae District is divided into three basic land use designations (urban, agriculture, and conservation) under the State Land Use Classification System. Agriculture and conservation uses comprise the dominant land use.

Urban lands are aggregated along the coast, and most of the valleys are classified as agriculture. The

Figure 4-2:
Oahu Land Use Designations



Source: Department of Planning and Permitting, City and County of Honolulu, 1997

conservation area encompasses the steep ridges and valley walls, including the Waianae Mountains surrounding Makua. Figure 4-4 provides a breakdown of land use for the Waianae District of Oahu.

Waianae Sustainable Communities Plan The land use and environmental planning process for the Plan area is a physical and conceptual framework that focuses on extensive community participation and an understanding of the natural and cultural resources of Waianae. The Plan was prepared in accordance with the Charter-prescribed requirements for development plans and is intended to guide public policy, investment, and decision-making over the next 20 years. This Plan is oriented to maintaining the area's unique character, current population, growing families, rural lifestyle, and economic livelihood. Although the Plan is a policy, and therefore not regulatory in nature, when used along with the City programs and budgets it serves as a policy guide for more detailed zoning regulations, as well as public and private sector investment decisions.

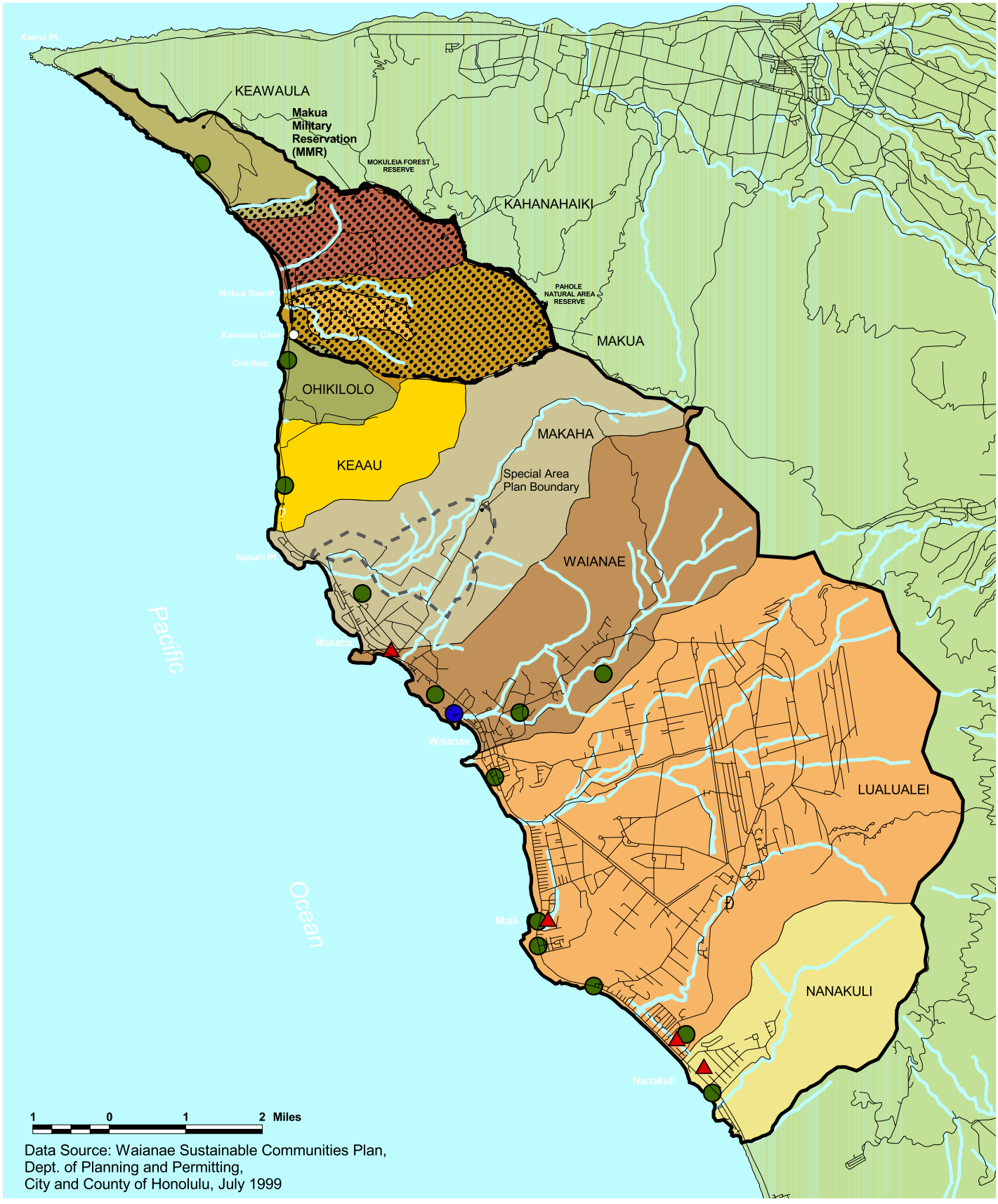
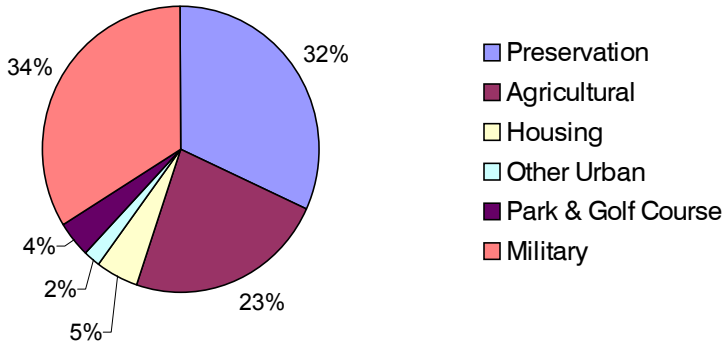


Figure 4-3:
Waianae Planning Districts

The Plan recognizes the traditional Hawaii ahupua'a, a land division that usually stretches from the fishing seas to the mountains and is defined by the natural geologic and topographic form of steep-walled valleys. The ahupua'a of Waianae surround the natural stream systems of each valley along with their historic and agricultural lands. There are nine ahupua'a in the Waianae District. Makua is located within Makua and Kahanahaiki ahapua'a. (Figure 4-3)

The Plan identifies a long-range plan for Makua to be preserved as agriculture/open space and preservation. However, it also recognizes the importance of the continued use of Makua for the foreseeable future due to its importance for training and its mission and overall economy of the State of Hawaii and the City and County of Honolulu.

Figure 4-4:
Waianae Land Use Designations



Source: Department of Planning and Permitting, City and County of Honolulu, 1997

The Plan establishes the four primary land types as preservation, coastal, agricultural, and rural community (Figure 4-1). These lands have clearly defined boundaries that guide general policy on future development, zoning-related resource management, and land use permits or entitlements.

4.2.2 Environmental consequences of No Action The No Action alternative is described in detail in 3.2. After completion of the disposal process, changes to land use could occur. Change to any land use other than military would probably necessitate UXO cleanup. Any area subject to limited public access (e.g., livestock grazing, wildlife preserve) would require UXO cleanup to a minimum of 1 foot below the ground surface over the entire subject area; any area of public access (e.g., agriculture, recreation) must be cleaned to a depth of 4 feet; and any area of unrestricted access (e.g., commercial, residential, utility) to 10 feet, or excavation depth plus 4 feet, whichever is greater, per Department of Defense (DoD) 6059.9-STD (DoD, 1999a). The excavation would subject the cleanup area to extreme surface disruption that could affect types of activities present after the remediation process. The

disturbance would need to be mitigated after cleanup. If the land is not retained by the federal government and reverts to the State, it would likely be re-designated as agricultural/open space or preservation land use, as called for in the Waianae Sustainable Communities Plan. These potential impacts would be analyzed and evaluated in the NEPA disposal document.

4.2.3 Environmental consequences of Proposed Action Under the Proposed Action, the Army would continue using Makua Military Reservation as a CCAAC, but at a level reduced from past practices. In particular, use of the CCAAC would not include the use of TOW missiles, incendiary munitions, or tracers. Of the 4,190.47 acres under Army jurisdiction, only 457 acres would be used for modified training and associated activities. The Proposed Action includes natural and cultural resource management, wildland fire management, public involvement, and other programs. This alternative would allow the Army to execute its required training missions, and would not involve costs and other effects of range clearance and closure. Makua's land use designation would remain as military use as recognized for the foreseeable future in the Waianae Sustainable Communities Plan. No change to Makua land use or the Waianae District and surrounding land use would occur as a result of the Proposed Action.

There would be no conversion of land use; however; the Army would continue to implement ITAM and other environmental programs. Development and implementation of new programs through public involvement and coordination with the City and County of Honolulu would continue to take place; therefore no new minimization measures are necessary.

4.3 GEOLOGY AND SOILS

4.3.1 Affected environment Makua is situated in the horseshoe-shaped Makua Valley, and is isolated in part by the Waianae Mountains to the north, east, and south, and by the Pacific Ocean to the west. The valley floor varies from 20 to 400 feet in elevation, and the mountain range has heights of 2,100 to 2,900 feet (US Army, 2000). Makua Valley includes Kahanahaiki Valley, and the Koiahi Gulch.

The Waianae Range and the Coastal Plain (including Makua Valley) are two of four major physiographic provinces on Oahu. The Waianae Range is volcanic, and is composed of thin basaltic lava flows with few ash flows. The range is divided into the lower/middle and the upper members of the Waianae Volcanic series. The lower/middle members consist of lava of the main shield-building stage. These lavas are primary lavas of great thickness and are composed of tholeiitic basalt, olivine basalt, and oceonite. The upper members consist of late-stage volcanics. They are composed of alkalic olivine basalt, ankaramite, mugearite, hawaiite, and trachyte. The Coastal Plain materials in Makua Valley consist mainly of noncalcareous, undifferentiated sedimentary materials, except for a narrow strip on the west coast boundary that consist of calcareous sedimentary materials deposited by the ocean. The Makua Valley sediments are underlain by a thick sequence of basalt, with some ash and other volcanic rocks. Surface materials are composed of rocks of the Waianae volcanic series, and of alluvial sediments and marine sands. The central part of the valley is filled with a sequence of alluvium. The overburden is relatively thin near the coast (50 to 115 feet in the vicinity of the installation boundary) and increases in thickness because of the topographic rise up the valley. The overburden becomes thinner near the mountain range; therefore, this area is dominated by volcanic rock. The western coastal area is characterized as beach, dune sands, and beach rock (Halliburton NUS Corporation, 1994). Figure 4-5 shows the spatial distribution of the different geologic units.

Table 4-1:
Soils and selected soil properties

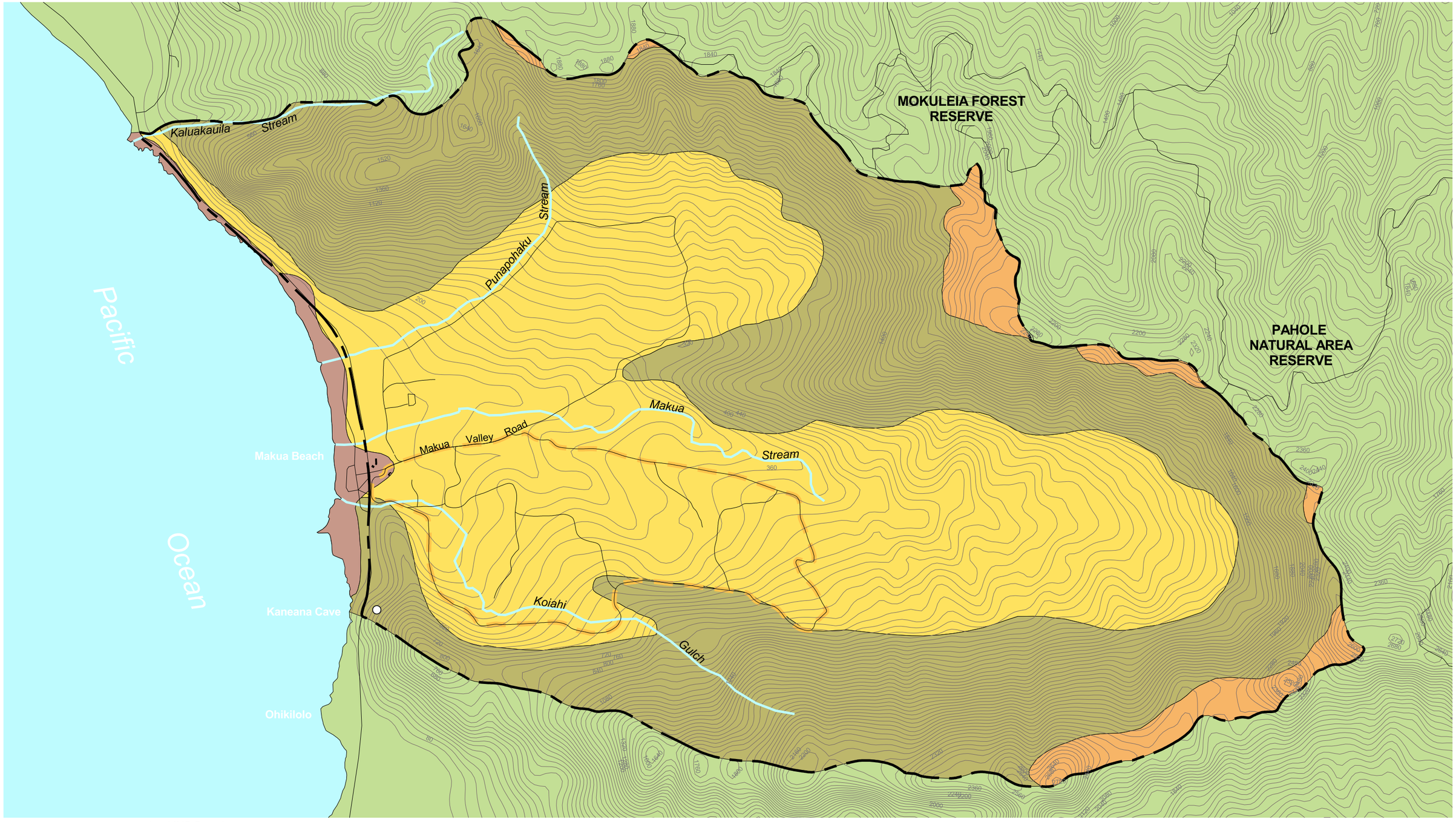
Soil Survey Level	*Map Unit*	*Soil Series*	*Textural Class (2)*	*Percent Slope*	*Shrink-swell potential*	*Corrosivity 1. Steel 2. Concrete*	*Depth to bedrock (feet)*	*Runoff/ Erosion Hazard*	*Capability Classification (3)*
High or Medium Intensity	EmA	Ewa	SiCL, mod. Shallow	2-6	Moderate	1. low 2. low	>5	Very slow/slight	IV (IIs)
	LoB	Lolekaa	SiC	3-8	Moderate	1. high 2. moderate	>5	Slow/slight	IIe
	LoC			8-15				Slow to medium/slight to moderate	IIIe
	LoE			25-40				Medium to rapid/moderate to severe	VIe
	MnC	Mamala	Stony SiCL	0-12	Low	1. low 2. low	1-1.5	Very slow to medium/slight to moderate	VIs (IIIs)
	PsA	Pulehu	CL	0-3	Moderate to low	1. low 2. low	>5	Slow/slight	IVc (I)
	PvC	Pulehu	Very stony CL	0-12				Slow to medium/slight to moderate	IVs
Low Intensity	BS	Beaches	(1)	(1)	(1)	(1)	(1)	(1)	VIIIw
	HLMG	Hele-mano	SiC	30-90	Low	1. moderate 2. low	>5	Medium to very rapid/severe to very severe	VIIe
	LPE	Lualualei	Extremely stony C	3-35	High	1. moderate 2. low	>5	Medium to rapid/moderate to severe	VIIs
	rAAE	Alakai	Mucky peat	0-30	(1)	1. high 2. high	>5	Slow/slight	VIIw
Reconnaissance	rRK	Rock land	(1)	(1)	(1)	(1)	(1)	(1)	VIIs
	rRO	Rock outcrop	(1)	(1)	(1)	(1)	(1)	(1)	VIIIs
	rST	Stony land	(1)	(1)	(1)	(1)	(1)	(1)	VIIs
	rSY	Stony steep land	(1)	(1)	(1)	(1)	(1)	(1)	VIIs
	rTP	Tropo-Humults Dystran Depts	(1)	(1)	moderate	1. high 2. high	>5	(1)	VIIe

(1) Information not available

(2) SiCL = silty clay loam; SiC = silty clay; CL = clay loam; C = clay.

(3) Capability classification shows general suitability for agriculture. Numbers in parentheses represent irrigated situations. Roman numerals I through VIII indicate progressively greater limitations and narrower choices for practical use. The small letter subclass indicates main limitation: e = erosion; s = shallow, droughty or stony; and c = for climate too cold or too dry.

Source: The Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii (USDA, 1972).



MMR Boundary
Road/Trail
Stream
CCAAC impact area boundary
Other lands

Geology

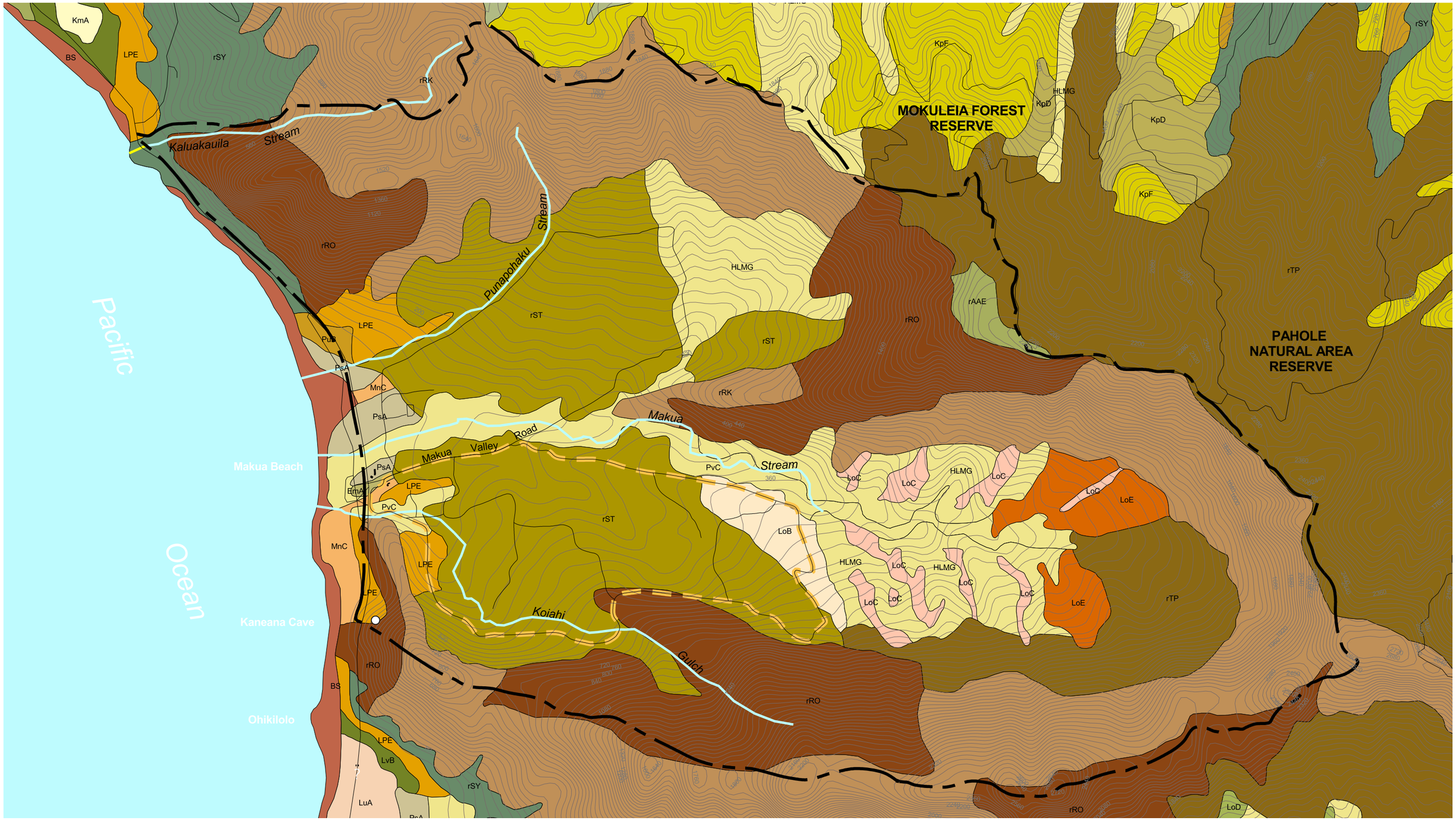
- Calcareous Sedimentary Materials (Includes Coral Rubble and Beach Sand)
- Noncalcareous Sedimentary Materials (Undifferentiated)
- Waianae Volcanic Series and Dikes (Lower and Middle Members)
- Waianae Volcanic Series (Upper Member)

0.5 0 0.5 Miles

Contour Interval: 40 Feet

Data Source: Geologic Map of the Makua Military Reservation, K. J. Takasaki, 1971

Figure 4-5: Geology



MMR Boundary
Road/Trail
Stream
CCAAC Impact Area Boundary

BS	FL	KaeB	KmA	LoD	MBL	PsA	rRO
EaC	HJE	KaeD	KpD	LoE	McC2	PuB	rST
EmA	HLMG	KanE	KpF	LPE	McD2	PvC	rSY
EwC	JaC	KlA	LoB	LuA	McE2	rAAE	rTP
	KaB	KlbC	LoC	LvB	MnC	rRK	

Data Source: Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii, USDA Soil Coservation Service, August 1972

Figure 4-6: Soils

The soils in Makua Valley have been mapped by the former US Soil Conservation Service (now NRCS, Natural Resource Conservation Service) and published in the Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii (USDA, 1972). Figure 4-6 shows the location and extent of the mapped soils, and Table 4-1 summarizes selected soil properties for Makua Valley soils. The soils were mapped at three different soil survey levels: (1) high/medium intensity survey, (2) low intensity survey, and (3) reconnaissance survey.

Much of the valley is identified as Stony Land (rST) (see Figure 4-6) consisting of a mass of stones and boulders which were deposited by water and gravity, and which cover 15 to 90 percent of the surface. The soil among the stones consists of reddish, silty clay loam similar to Ewa (EmA) soils and very dark grayish-brown clay similar to Lualualei (LPE) soils. A Land Management/Erosion Control Study was conducted for Makua (Walter Lum Associates, 1979). As a part of this study, soil samples were taken at three locations and generally tested low in fertility. The study identified erosion problem areas to be confined to the demolition pads, firebreak roads, and denuded areas near the top one-third to one-half of the steep gulch walls in Makua Valley. Gulch walls on the upper valley and firebreak roads experienced some erosion as well. Fire increases erosion hazards due to the loss of vegetative cover; however, it was observed that guinea grass vegetation in recently burned areas recovered itself in about a month after the early November rain (Walter Lum Associates, 1979). The Universal Soil Loss Equation developed by USDA to calculate soil erosion losses were applied to Makua. The results are shown in Table 4-2.

Table 4-2:
Soil erosion losses

Landform	*Eroded Areas (tons/acre/year)*	*Vegetated Areas (tons/acre/year)*
Uplands	4 to 57	2.3
Gulches	191 to 338	6.8

Source: Land Management/Erosion Control Study USASCH Installations, Hawaii Makua (Walter Lum Associates, 1979)

Based on the calculated soil erosion losses, a severity rating number was computed for Makua soils. The City and County of Honolulu has adopted a severity rating of 50,000 as acceptable in an urban improvement area. Exposed and/or eroded areas due to military operations have a severity rating of 34,900, while naturally exposed and/or eroded areas have a severity rating of 75,700. Because this number exceeds the acceptable severity rating of 50,000 and because general erosion was observed in smaller areas as described above, the following erosion control techniques have been implemented to reduce erosion at Makua:

- Surface roughening
- Interception and diversion of channel waters
- Gravel check dams to dissipate the erosive force of water
- Graded gravel for firebreak road and cleared areas in lieu of grassing
- Surface cross drains or shallow ditches to reduce water volume and velocity
- Dust control
- Vegetative cover of native grasses

In addition, the Army's ITAM program is implemented on Makua. Specific ITAM actions pertaining to protection of soil and geology resources include:

- Cease training on a given parcel of land due to severe impacts and initiate restoration of the parcel
- Schedule and allocate lower impact training to a given parcel to reduce adverse effects and allow for natural recovery or longer sustained use
- Re-designate the parcel's use to an alternative training, mission, or non-mission activity to permit natural recovery, prolong sustained use, or allow for re-habilitation, repair or maintenance.
- Implement a road maintenance program
- Administer soil erosion control

4.3.2 Environmental consequences of No Action The No Action alternative is described in detail in 3.2. Potential impacts to geology and soil from cleanup would include grading, excavation, fill, and erosion would be significant. The ITAM program presently provides prevention and repair of soil erosion but would no longer be implemented. The cessation of training would eliminate soil disturbance from vehicles and munitions, but would take time to stabilize after the UXO cleanup process. However, these potential impacts would be analyzed and evaluated in the NEPA disposal document.

4.3.3 Environmental consequences of Proposed Action Reduced and modified training at Makua will result in minor soil erosion due to maneuver activities, maintenance of firebreak roads, and use of munitions. When compared to the impact of past training activities, soil erosion is expected to decrease. As part of the Proposed Action, ITAM and land management/erosion control measures are incorporated and would continue to be implemented to stabilize and reduce soil erosion. The implementation of the wildland fire management plan and the elimination of tracers are expected to reduce fires, which in turn is expected to reduce possible soil surface disturbance due to loss of vegetative cover.

4.3.3.4 Conclusion No significant impacts to geology and soils are expected because of the ITAM program of education and erosion control, reduced erosion from previous activities and fire management activities. Impacts on soil conditions stemming from the Proposed Action are not anticipated to have a significant impact on flora, fauna or marine life. The Army would continue to implement the Land Management/Erosion Control measures to reduce impacts to soil and geology resources.

4.4 CLIMATE AND HYDROLOGY

4.4.1 Affected environment

4.4.1.1 Climate The climate of the West Coast of Oahu and Makua is greatly influenced by the Waianae Mountain Range on the southeast side of the island, and the Koolau Mountain Range on the northeastern side. The Koolau Mountains intercept the moisture-laden trade winds from the northeast, causing high rainfall over the upper elevations. This reduces the moisture in the trade winds reaching the Waianae Mountains. Makua is located in a rain shadow (an area of decreased rainfall) on the leeward side of the island; annual rainfall averages range from 15 inches (380 millimeters) at the valley mouth to 50 inches (380 millimeters) near the head of the valley (US Army, 2000). Temperatures vary over a range

from 79.6 to 86.7 degrees Fahrenheit. The lack of rainfall, warm temperatures and topography features result in an arid climate. In fact, Makua is located on the most arid portion of Oahu (US Army, 2000). Nonetheless this climate supports a diverse mixture of vegetation types (USAH and 25th ID(L), 1999).

The Army operates three automated weather stations at Makua (Figure 4-7) used in calculating the risk of wildland fire danger. One is located in the Waianae Mountains near the northeast boundary of Makua; the second is centrally located near the Pacific Coast; and the third is located midway up the valley.

4.4.1.2 Hydrology Executive Order 11990, "Protection of Wetlands," says that "each agency shall provide leadership and shall take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands…"

There are no delineated wetlands on Makua or hydric areas along the stream banks within Makua. There are four streams in Makua Valley. Makua Stream and its tributaries, which originate on the western slope of the Waianae Range, drain most of Makua. The Makua Stream system is an intermittent system and flows only about 5 percent of the year. The stream rarely flows for two consecutive days (US Army, 1993). This is a typical characteristic of streams in arid regions.

Three other intermittent streams at Makua also drain the eastern higher elevations west to the Pacific: Kaluakaula Stream borders the northern boundary of Makua; Punopahaku Stream is northern-centrally located; and the Kaiahi Gulch is found in the southern portion of Makua (Figure 4-7). Muliwai (small ponds) are located near the outlets of streams. The muliwai are transition zones between the streams and the Pacific Ocean, and their water levels and salinity vary daily. No areas of inundation have been identified at Makua.

The two types of groundwater identified on Makua are the Basal Water Body and the Waianae Dike-Impounded Water Body. Fresh water can be found at lower elevations in sedimentary calcareous sands and younger alluvial deposits found near the coast and in the upper portions of the valley area at the bottom of incised stream channels. The freshwater supply in sediments near the coast is limited by the low permeability and limited recharge capacity of the alluvium, the low storage capacity and highly transmissive characteristics of the talus located at the foot of steep rocky slopes, and saltwater intrusion (US Army, 1997c).

There are no water supply wells at Makua. A monitoring well drilled near the administrative building reached groundwater at 16.3 feet (US Army, 1993)

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4.4.1.3 Flood hazards Executive Order 11988, "Floodplain Management," states that "each agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains…"Flooding on Oahu is caused by severe rainstorms and tsunamis. A tsunami is a series of waves generated by undersea disturbances such as earthquakes, landslides, or volcanic eruptions (Federal Emergency Management Agency [FEMA] website). Tsunamis can occur at any time during the year, day or night. While tsunamis have reached elevations of more than 100 feet above sea level, areas at greatest risk are those within 1 mile of the ocean shoreline and at elevations less than 50 feet above sea level (FEMA website). Although the Island of Hawaii has experienced the most severe damage from

tsunamis, Oahu has also been affected: tsunamis struck the coast in 1946, 1952, 1957, 1960, and 1964. Civil Defense Tsunami Evacuation Maps available from the Pacific Disaster Center show estimated evacuation areas. Near Makua the area includes the entire coastline west of Farrington Highway and, in some areas includes land extending as far as 1,200 feet east of the highway. The maps show the closest tsunami shelter is Makaha Elementary School in Makaha Valley approximately 4 miles south of Makua.

Flood Insurance Rate Maps (FIRMS) depict the 100-year tsunami/storm (a tsunami/storm with a one percent chance of occurring in any given year) floodplain for the City and County of Honolulu. FEMA uses two zones to depict inundation areas for the 100-year tsunami. Zone VE shows the area where the 100-year tsunami depth exceeds 4 feet and the AE depicts areas where inundation is less than 4 feet. The floodplain is generally limited to coastal areas in the vicinity of Makua, but along the Makua coastline there is no floodplain mapped. FEMA maps show that Makua and adjoining areas are Zone D, or areas in which flood hazards are undetermined. Therefore, no flood hazard or floodplain studies have been completed by FEMA for the area. The Proposed Action does not include any construction that would alter the current topography of low-lying areas. However, it can be expected that flood hazards near Makua are greatest along the coastline and likely extend to Farrington Highway and eastward of the highway in some areas.

4.4.2 Environmental consequences of No Action The No Action alternative is described in detail in 3.2. There would be no foreseeable impacts to hydrology, climate or flood hazards.

4.4.3 Environmental consequences of Proposed Action This action would not alter or impact the climate, current hydrology, or the flood hazard area.

4.5 VEGETATION AND WILDLIFE

4.5.1 Affected environment The vegetative community of Makua is diverse and has been extensively studied and documented in the US Army "Biological Assessment for Programmatic Section 7 Consultation on Routine Military Training at Makua Military Reservation" (1998). The following is a summary of the findings of the Biological Assessment (BA). This portion of the SEA discusses species that are not listed as either threatened or endangered; threatened and endangered species are discussed in 4.6.

4.5.1.1 Vegetation Three native ecological zones, listed below and shown in Figure 4-8 (Ecological Zones, Biological Zones, and Management Units), have been identified within Makua. The Army delineated these zones based on elevation, topography, and prevailing climatic conditions within the Reservation, resulting in three designations: a Ridge Crest Vegetation Zone, a Native Shrub on Cliff and Slope Zone, and a Lowland Native Forest Zone.

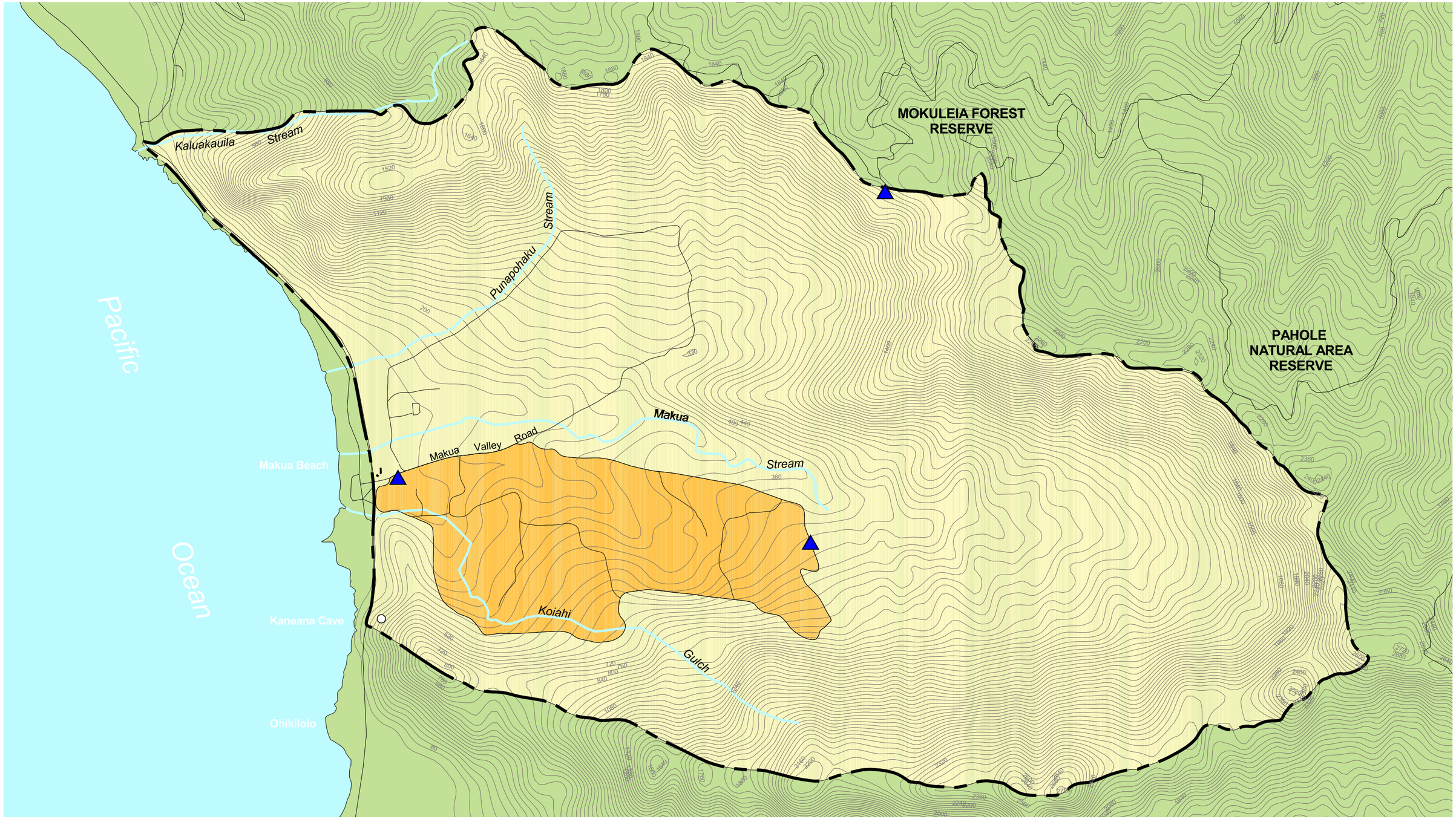

Figure 4-7: Weather Stations, Floodplains, and Intermittent Stream System

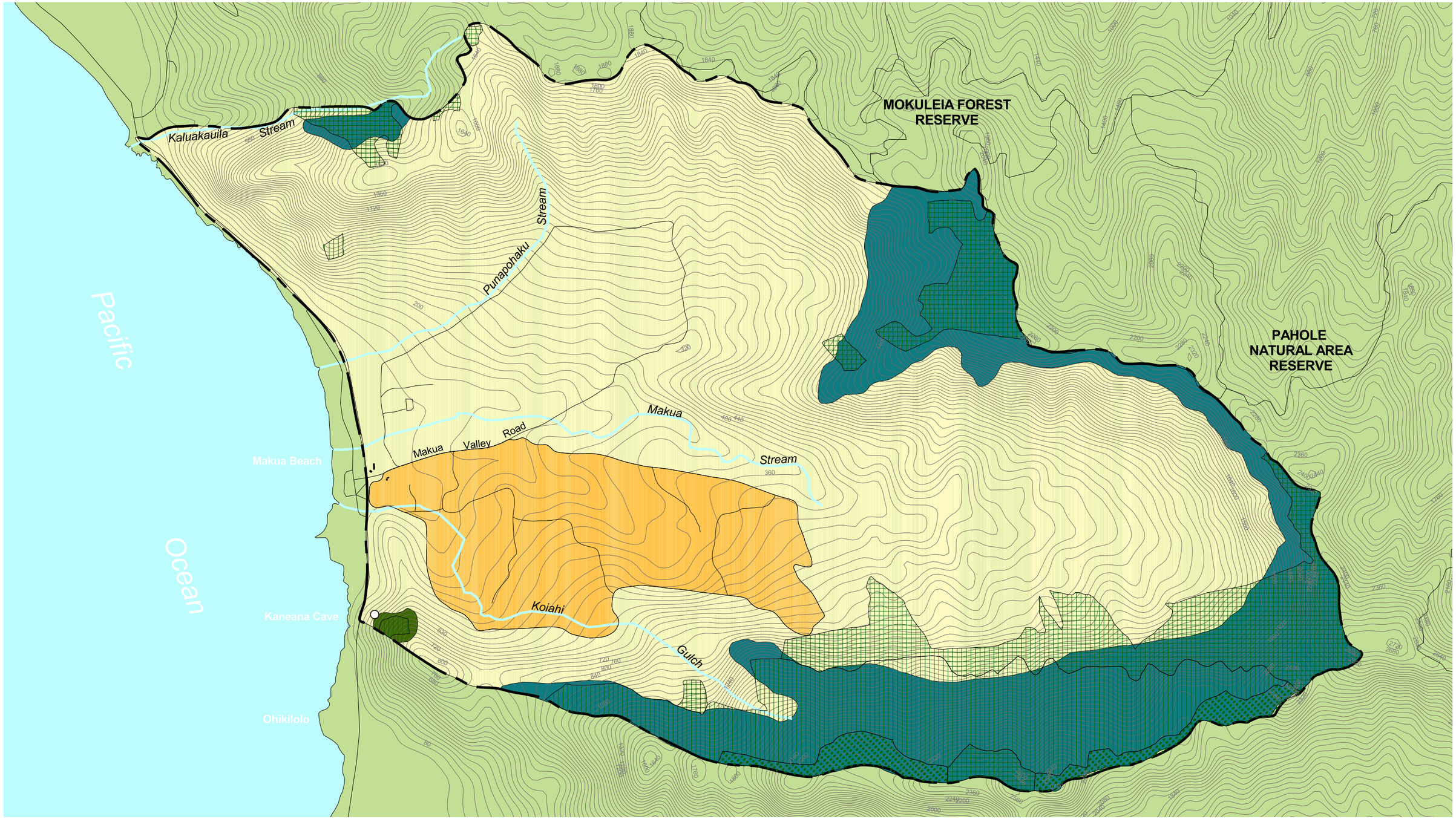

Figure 4-8: Ecological and Biological Zones

Within the Lowland Native Forest Zone, six native natural community types exist on the Reservation. Two of these community types are rare and some of the community types, although not rare themselves, support rare species. A description of these zones and the predominant community types that characterize each zone is provided as follows. Descriptions of plant community types and zones were taken from the US Army *Final Biological Assessment for Programmatic Section 7 Consultation on Routine Military Training at Makua Military Reservation* (US Army, 1998)

The *Ridge Crest Vegetation Zone* lies above approximately 3,000 feet elevation in the summit of the Waianae Mountains. Prevailing conditions are cool, usually wet, windswept, and often cloud-shrouded. This zone is typically located on slopes too steep to support trees. The dominant community type that exists within this zone is the 'Ohi'a Lowland Mesic Shrubland. These shrubland areas are found at Makua along the southeastern and southern rim of Makua Valley, from the valley rim down the walls to about 2,500 feet in elevation. *Metrosideros tremuloides* is the dominant plant community found in this zone. Other native trees include kopiko (*Psychotria hathewayi*), kolea (*Myrsine lessertiana*), and *M. polymorpha*. The understory species include Ko'oko'olau (*Bidens torta*), 'a'ali'i (*Dodonaea viscosa*), pala'a (*Odontosoria chinensis*), 'okupukupulau'i'i (*Doodia kunthiana*), *Carex meyenii*, and kawelu (*Eragrostis grandis*).

Rare species observed in this shrubland include, *Sanicula mariversa*, na'ena'e (*Dubautia herbstobatae*), loulu (*Pritchardia kaalae*), *Tetramolopium filiforme*, halapepe (*Pleomele forbesii*), alani (*Melicope makahae*), and nehe (*Lipochaeta tenuifolia*).

In the Waianae area, natural communities in the *Native Shrub on Cliff and Slope Zone* ecological zone inhabit elevations between 1,500 feet and 2,400 feet on slopes and ridges beneath steep cliffs. Conditions are not nearly as wet or cool as in the Ridge Crest Zone. Lowland dry shrubs and mosses that favor a mesic habitat characterize this zone. This zone is predominantly located on steep vertical cliffs at Makua. The two plant community types that characterize this zone include the A'ali'i Lowland Dry Shrubland found on moderate slopes and the Hawaiian Mixed Shrub Lowland Dry Cliff found on steeper slopes.

Small patches of 'a'ali'i (*Dodonea viscosa)* shrubland are found on the slope and ridges below steep cliffs in Kahanahaiki Valley and portions of Makua Valley and along the Makua-Keaau Ridge below the ridge crest. Adjacent communities include native shrublands on steep cliffs, Lama Lowland Dry Forest stands, and alien-dominated grasslands and shrublands in fire-disturbed areas. The patches of 'a'ali'i shrubland at Makua were not particularly diverse, but included shrubs such as 'ilima (*Sida fallax*), alahe'e (*Canthium odoratum*), and ko'oko'olau (*Bidens cervicata*). Dryland mosses are present in crevices of rocky sections, as were herbs 'ala'ala wai nui (*Peperomia leptostachya*) and *Plectranthus parviflorus* and the fern kumuniu (*Cheilanthees decipiens*).

The Hawaiian Mixed Shrub Lowland Dry Cliff community is found along the drier cliff faces such as those below 2,400 feet on the south-facing walls of both Makua Valley and Koiahi Gulch. The most common shrubs include ko'oko'olau (*Bidens* spp.), hinahina (*Artemisia australis*), 'akoko (*Chamaesyce celastroides*), and 'a'ali'i (*Dodonaea viscosa*). Native grasses and sedges such as kawelu (*Eragrostis grandis*) and *Carex meyenii* are present in this area.

Rare plants observed on the cliffs within the Hawaiian mixed shrubland, including the kulu'i (*Nototrichium humile*), *Lobelia niihauensis*, na'ena'e (*Dubautia herbstobatae*), nehe (*Lipochaeta*

tenuifolia) ma'aloa (*Neraudia angulata*), *Sanicula mariversa*, *Silene lanceolata*, *Tetramolopium filiforme*, *Viola chamissoniana* spp. and *Spermolepis hawaiiensis*.

The *Lowland Native Forest Zone* occurs between 1,000 feet and 2,700 feet on slopes moderate enough to support trees and contains dry, mesic and wet forest typified by native lowland shrub and tree species. The following six community types characterize this zone:

- Koa/'Ohi'a Lowland Mesic Forest
- Lama Lowland Dry Forest
- Lama/'Ohi'a Lowland Mesic Forest
- Loulu Lowland Mesic Forest (rare natural community type*)*
- Oahu Diverse Lowland Mesic Forest (rare natural community type)
- 'Ohi'a Lowland Mesic Forest

The *Koa/Ohi'a Lowland Mesic Forest* community is found along the northern rim of Makua Valley at elevations between 2,000 and 2,300 feet. South-facing, gentle slopes of soil over weathered basalt characterize this area. The dominant plant species in this community type is the koa (*Acacia koa),* and the 'Ohi'a (*Metrosideros polymorpha*). Some of the trees present in this forest type include mehame (*Antidesma platyphyllum*), 'ahakea (*Bobea brevipes*), and two species of lama (*Diospyros sandwicensis* and *D. hillebrandii*). The understory includes manono (*Hedyotis terminalis*), pukiawe (*Styphelia tameiameiae*), and ko'oko'olau (*Bidens torta*). Ferns such as palapalai (*Microlepia strigosa*), *Dryopteris unidentata*, and pala'a (*Odontosoria chinensis*) are present as well as the native sedge uki (*Dianella sandwicensis*) and *Carex* spp.

Rare plant species at Makua within this forest type include ma'aloa (*Neraudia melastomifolia*), *Cenchrus agrimonioides* var. *agrimonioides*, *Schiedea nuttallii* var.*nuttallii*, and alani (*Melicope sandwicensis*). The endangered tree snail (*Achatinella mustelina*) was also observed in this plant community.

Small stands of the *Lama Lowland Dry Forest* are present along survey routes between 1,000 feet and 1,300 feet elevation in the Koiahi Gulch and the south side of Makua Valley. Lama (*Diospyros sandwicensis)* is the dominant tree; other native trees present in the canopy include wiliwili (*Erythrina sandwicensis)*, olopua (*Nestegis sandwicensis*), and alahe'e (*Canthium odoratum*). The understory is relatively open in this area with some native shrubs. The most abundant shrub present is the alahe'e. In addition, lama saplings, 'akia (*Wikstroemia oahuensis*), 'a'ali'i (*Dodonaea viscosa*), and 'ilima (*Sida fallax*) are present. The native vine huehue (*Cocculus trilobus*), native ferns and mosses are also found in these areas.

Lama/'Ohi'a Lowland Mesic Forest is located at elevations between 1,200 feet below the 'Ohi'a Lowland Mesic forest of the upper valley rim. The dominant plant species in this community is the lama (*Diospyros sandwicensis*) and the 'Ohi'a (*Metrosideros polymorpha*). At the lower elevation limits of this forest type, the 'Ohi'a becomes subdominant and often times is absent.

Several rare plant species are present in this forest type, including the trees mahoe (*Alectryon macrococcus* var. *macrococcus*), kaulu (*Pteralyxia macrocarpa*), 'ahakea (*Bobea sanwicensis* and *B. timonioides*), halapepe (*Pleomele forbesii*), mehamehame (*Flueggea neowawraea*), keahi (*Nesoluma polynesicum*), and 'aiea (*Nothocestrum latifolium*). Relatively few living endangered tree snail were found

in this forest type; however, many dead shells from this snail and other native snail species in the soil and litter of the lama/'ohi'a forest stands were observed.

Loulu Lowland Mesic Forest (rare natural community type), a unique type of Loulu Lowland Mesic Forest dominated by loulu (*Prittchardi* k*aalae*), occurs on the north face of the Makua-Keaau ridge in the Waianae Mountains of Oahu at about 2,700 feet. Loulu occurs at other sites in the Waianae Mountains, but only at the Makua-Keaau site does it form a closed canopy stand of trees. This closed canopy forest at Makua is the only known example of this rare community and covers about 1 acre. This loulu forest grades rather abruptly into the surrounding 'ohi'a forest and shrubland communities. Other trees dispersed within this forested area include 'ohi'a (*M. polymorpha* and *M. tremuloides*), kolea (*Myrsine lessertiana*), and kopiko (*Psychotria hathewayi*). Understory includes naupaka (*Scaevola gaudichaudiana*) and au (*Hedyotis acuminata*). The ground cover consists of ferns such as 'okupukupulau'i'i (*Doodia kunthiana*), *Dryopteris unidentata*, *D. fusca-atra*, and lepelepe-a-moa (*Selaginella arbuscula*).

The *Oahu Diverse Lowland Mesic Forest* (a rare natural community type) has a large number of tree species with no single species dominant. Therefore, these forests are not named for the dominant species, but for the island where they appear. The substrate of the diverse forest is rocky, sometimes with a steep talus slope with large rocks and almost no soil. At Makua, one stand of this forest type is present at 2,100 feet at the back of Makua Valley, just west of the valley rim. The native canopy trees include lama *(D. sandwicensis* and *D. hillebrandis*), 'ala'a (*P. sandwicensis*), koki'o ke'oke'o (*Hibiscus arnottianus*), olopua (*Nestegis sandwicensis*), papala (*Charpentiera tomentosa*), papala kepau (*Pisonia umbellifera* and *P. sandwicensis*), kopiko (*Psychotria mariniana* and *P. Hathewayi*), kolea (*M. lessertiana* and *M. lanaiensis*), and hame (*Antidesma platyphyllum*). Shrubs in this area include au (*H. acuminata*) and pilo (*Coprosma foliosa*). The native ground cover consists of ferns such as palapalai (*Microlepia strigosa*) and hoi'o (*Diplazium sanwichianum*).

Three rare plants exist in this forest type at Makua, including the tree mahoe (*Alectryon macrococcus* var. *macrococcus*), the shrub kamahahala (*Labordia kaalae*), and the fern pauoa (*Ctenitis squamigera*). The endangered tree snail (*A. mustelina*) was also observed on trees, shrubs and ferns in this area.

The *Ohi'a Lowland Mesic Forest* dominates many of the ridge tops of the southeast portion of the valley head walls above 2,000 feet. This forest type that is dominated by the 'Ohi'a (*Metrosideros)* tree, is the major habitat area for the endangered tree snail (*A. mustelina*). The following rare plants are known to exist in this forest type at Makua: alani (*Melicope sandwicensis*), *Cenchrus agrimonioides* var. *agrimonioides, Alsinidendron obovatum, Schiedea nuttallii var. nuttallii,* and *S. purpurea* var. *purpurea*.

In addition to the nine native natural community types identified above, two additional plant communities have become established as a result of human disturbances and introduction of exotic species. These are described in the following paragraphs.

Alien Grassland/Open Shrubland is found in portions of Makua, particularly areas that have been subjected to repeated fires, generally characterized by fire-tolerant and fire-adapted grasses and shrubs. The primary grass species include guinea grass (*Panicum maximum*) at lower elevations, natal redtop (*Rhynchelytrum repens*), molasses grass (*Melinis minutiflora)*, and thatching grass (*Hyparrhenia rufa*), among others. Native fire-tolerant shrubs such as 'a'ali'i (*Dodonaea viscosa*) and 'iliahi (*Santalum ellipticum*) persist on a few alien grass-dominated ridges in Kahanahaiki Valley. Open shrublands are

dominated by scattered koa haole (*Leucaena leucocephala*), klu (*Acacia farnesiana*) and an occasional kiawe (*Prosopis pallida*).

Alien Forest/Closed Shrubland extends over about half of the forested area at Makua, and includes Java plum (*Syzygium cumini*), Christmas berry (*Schinus terebinthifolius*), and guava (*Psidium guajava* and *P. cattleianum*). Kukui (*Aleurites moluccana*) and Java plum forest occupy gulch bottoms in the valley and side gulches, whereas Christmas berry and guava tended to occupy the lower slopes at the head of the valley and away from the gulches. As recently as a few decades ago, kiawe (*Prosopis pallida*) forest was another important alien vegetation component along the coast and dry lowlands at Makua. However, repeated fires have caused most of this forest type to be replaced with fire-adapted grasslands and shrublands.

4.5.1.2 Wildlife As a part of a comprehensive biological inventory and management assessment, a biological survey of vertebrates was conducted in 1993 by the Hawaii Natural Heritage Program (HINHP) (Hawaii Natural Heritage Program, 1994). Vertebrate surveys were conducted to compile a list of birds and mammals. In this report, only the rare and endangered animals have been summarized (see 4.7). Ronald L. Walker (as cited in US Army, 1999) conducted a vertebrate survey in 1967 that detected 19 bird taxa including, the native apapane (*Himatine sanguinea),* Oahu amakihi (*Hemignathus virens chloris)* and Oahu elepaio *(Chasiempis sandwichensis ibidis).* Currently only the Oahu elepaio is known to exist in small numbers in the Kahanahaiki area of Makua.

Introduced nuisance species such as goats and pigs enter Makua from adjacent lands. Pig (*Sus scofa)* signs, (such as scat, tracks, and evidence of rooting) were observed throughout the mesic areas of Makua and Kahanahaiki valleys during the HINHP 1993 survey. Goats (*Capra hircus)* are found on the southern side of Makua Valley and in adjacent Makaha and Makaleha valleys. The Army has initiated a program to remove ungulates on the property because they adversely affect native species eating native and rare plants by uprooting plants, increasing erosion, and trampling on vegetation. The Army has constructed more than seven miles of fencing to limit the movement of goats and pigs onto Makua; this was completed in fiscal year 2000.

Additional introduced animal species such as feral cats (*Felis catus)*, mongoose (*Herpestes sp.)*, and rats (*Rattus sp.)*, have been observed on Makua. The Army has trapped and removed a large number of these animals as part of the program to protect endangered and other species. These introduced animals have been known to disturb the wildlife by competing for food and habitat and by killing native animal species.

4.5.2 Environmental consequences of No Action The No Action alternative is described in detail in 3.2. During the period between the decision to close Makua and the completion of disposal, there would be potential positive benefits to vegetation and wildlife because of the elimination of Army training. Because the Army's conservation and ecosystem management procedures would be reduced to minimal levels, there could be negative impacts to some vegetation and wildlife. The overall impacts during this period are undeterminable.

If the Army does not resume training at Makua, vegetation and wildlife would be subjected to less stress than they experience when the property is used for training, and native plant species would continue to grow in the higher elevations, but the Army would probably not continue its program of propagating

native species, nor would it actively seek to eliminate non-native animal and plant species. Potential impacts to vegetation and wildlife could include expansion of fire tolerant and invasive alien grasses, trees, and shrubs into areas occupied by native vegetation. Under this no action alternative, the Army may have to reconsult with the US Fish and Wildlife Service regarding cessation of interim stabilization measures identified in 4.6.3. However, some of the measures that are currently under way (*e.g.,* existing fencing) would be maintained during this caretaker period.

The actual type, timing, and location of future reuse activities are not known. Cleanup of UXO could significantly disrupt vegetation and habitats. Depending on designated land use of the property ranging from limited public access, agricultural unrestricted public access, the extent of excavation required for UXO cleanup could range from 1 to 14 feet below the ground surface. Excavation could subject the cleanup area to extreme surface disruption and disturbance of existing ecosystems. Disruption of native ecosystems would adversely impact both common and rare native wildlife and vegetation. The disturbance would need to be mitigated after cleanup. Nuisance wildlife populations could expand due to lack of population management and discontinued maintenance of fences that limit their movement onto Makua. Removal of military personnel and equipment could adversely impact the ability to prevent and fight wildland fires. These potential impacts would be analyzed and evaluated in the NEPA disposal document. Impacts to vegetation and wildlife could be significant.

4.5.3 Environmental consequences of Proposed Action All current environmental programs would continue and be expanded, including natural and cultural resource management, wildland fire management, interim endangered species stabilization, public involvement, and other programs. This alternative would allow the Army to execute its required training missions and would not involve costs and other effects of range clearance and closure.

Under the Proposed Action, the site would remain much as it is today. Native plant species would continue to grow primarily along the rim of the site in higher elevations and alien species would continue to grow in areas that have been disturbed by past fires and by the training course at lower elevations within the valley. Vegetation and wildlife in the 457-acre impact area would be disturbed by training activities, but the expanded environmental programs would enhance the environment in the remaining 376 acres of land actually used for training.

The Army has adopted several safeguards to minimize the threat of a fire escaping the firebreak roads. These safeguards would be implemented under the Proposed Action. Native plant species may perish in a wildfire, depending on the extent of a fire. Fires would allow fire-adapted alien grasses and shrubs to encroach on the native habitat. It is expected that with the fire controls the Army has adopted, an escaped fire would not burn to higher elevations. Therefore, since most of the native plants are located outside the firebreak road in the upper elevations, it is not expected that there will be a significant impact to native vegetation.

As part of the Section 7 Consultation, USFWS reviewed the Army's BA and Stabilization Plan for activities at Makua. In doing so, USFWS looked not only at endangered species, but also the ecosystems that are their habitats. Most of the rare, non-listed species reside in the same habitat as listed species. The consultation process is described in 4.6.3.1. The rare non-listed species will also benefit from the habitat management activities outlined in the Stabilization Plan. The Proposed Action, includes: monitoring and control of rats, goats pigs and weeds, monitoring and propagation of rare plants within Makua Military

Reservation, and monitoring of rare birds. Continuation of these ongoing actions substantially reduces naturally occurring threats to rare and other native non-listed vegetation and wildlife species at Makua. These protective measures are expected to enhance the environment for rare and other native non-listed vegetation and wildlife species.

Impacts on vegetation and wildlife stemming from the Proposed Action are not anticipated to be significant.

4.5.3.1 Minimization and stabilization measures Under the Proposed Action, the Army would continue and expand its conservation actions to offset adverse impacts from non-military threats such as ungulates and existing weeds. The Army would also continue its environmental monitoring and remove goats and pigs from Makua to protect native plant species from ungulate destruction. Erosion control would be implemented as needed.

Continued Army use of Makua would minimize alien weed introduction; a list of weed minimization strategies adopted by the Army is provided in 4.6.3.1. The native plant communities that exist at Makua would benefit under the Army's interim stabilization and propagation efforts, which are part of the Proposed Action. The Army will continually evaluate the environment to develop proactive management strategies.

Vehicle and foot traffic within Makua is primarily confined to the firebreak roads and areas within the CCAAC impact area. The Army briefs visitors and those training at the site on precautions to take in order to minimize the potential impact.

4.6 THREATENED AND ENDANGERED SPECIES

4.6.1 Affected environment

4.6.1.1 Biologically Sensitive Areas Habitat areas supporting numerous rare, threatened or endangered species have been given special status. Those areas are termed Biologically Sensitive Areas (BSAs) and are used in identifying and managing habitat for these native species (see Figure 4-8). Delineation of the BSAs assists the Army in setting resource management priorities. There are two BSA designations within the boundaries of the Reservation.

BSA-1 BSA-1 contains a high density of current occurrences of Federally listed endangered, proposed endangered and/or candidate taxa, and/or rare natural communities. As illustrated in Figure 4-8, there are two BSA-1s on the property. These include an extensive area (762 acres) along the entire eastern half of the Makua boundary extending into the interior of Makua and a small area (16 acres) along the southern boundary beginning about three-quarters of a mile east of the coastline (US Army, 2000).

BSA-2 BSA-2 areas contain lower densities of Federally listed endangered, proposed endangered, or candidate taxa. BSA-2 areas may also contain species of concern that are expected to be upgraded to Federally protected status within the next few years or areas judged likely to contain high densities of Federally-listed taxa based on a habitat assessment. A small area (8.5 acres) along the southern boundary beginning at Farrington Highway and extending east is designated as BSA-2 at Makua (US Army, 2000).

4.6.1.2 Management units The Army has designated management units where listed species are concentrated, and where many of the conservation stabilization actions are focused. The Management Units are described in Table 4-3 and shown in Figure 4-9.

4.6.1.3 Threatened and endangered species on Makua Records dating back to 1970 indicate that on Makua there are 32 listed plants (all endangered), two endangered birds *(*Oahu creeper or *Paroreomyza maculata,* and Oahu elepaio or *Chasiempis sandwichensis ibidis*), one endangered mammal (Hawaiian hoary bat or *Lasurius cinereus semotus*), and one endangered invertebrate snail (Oahu tree snail or *Achatinella mustelina*) (see Table 4-4). Some of these species may no longer exist at Makua. For example, the Oahu creeper has not been seen since the 1970s. No species listed as threatened is known to occur on Makua. In addition to listed species, there are records of 10 plant species recognized as species of concern, five plant candidate species recognized for threatened or endangered species status, and one animal species of concern present on Makua. Candidate species are species that may be warranted for listing as threatened or endangered by the USFWS, but insufficient information has been obtained by USFWS to justify their listing. Candidate species are not protected under the Endangered Species Act. "Species of concern" is a broad informal term that refers to those species that might be in need of concentrated conservation actions and are not federally listed. The actions vary depending on the health of the populations and degree and types of threats. Other endangered, threatened, and candidate species and species of concern occur on Oahu, but only those species listed in Table 4-4 have historical records dating back to 1970. None of these species is known to occur within the 1,034-acre area used as a CCAAC.

The 1994 Hawaii Natural Heritage Program assessment identified areas within Makua as *Achatinella* habitat. Species of the Oahu tree snail may be found above 900-foot elevations in the Waianae Range. The snails have been greatly reduced in number due to their extreme localization (often one species to a single tree), low reproductive rate, virtual lack of defense mechanisms, and a general dependency on relatively intact native forest conditions. Studies have concluded that the greatest threats to the Oahu tree snail are fire and habitat disturbance. The training areas have been reduced in recognition of this issue.

4.6.1.4 Section 7 Consultation history Section 7 of the ESA directs all federal agencies to use their existing authorities to conserve endangered species, and, in consultation with USFWS, to ensure that their actions are not likely to jeopardize the continued existence of listed species. Army consultation conducted with USFWS is summarized in the following paragraphs.

Section 7 consultations originally began in 1989-1991 for the Oahu tree snail. The following restrictions were established for training at Makua and resulted in a 1991 no-jeopardy biological opinion (BO) from the USFWS. (A BO is the USFWS opinion on the impacts of the Proposed Action on endangered and threatened species and their habitats.)

- The use of high fire-risk ordnance such as tracers and rockets is prohibited
- Fire-causing high explosive and tracer munitions cannot be fired at areas outside the existing firebreak road of the CCAAC
- The Army must furnish the USFWS with a semi-annual report of all fires escaping immediate control